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ABSTRACT

Having a good command over basic computer applications is essential for teachers to integrate technology in school. Teachers should learn how to maximize the power of computers for their teaching and administrative work. This paper focuses on some effective approaches that can help teachers learn to use computer applications successfully. First, common computer tasks were categorized based on their features into conceptual, declarative, and procedural tasks. A series of enhancement instruments was designed, developed, and implemented in computer application courses throughout a two-year period; subjects were 186 undergraduate preservice teachers and 112 graduate inservice teachers. Data were gathered and interpreted about effective approaches. The study focused on various tasks, instructional devices, and factors that may have contributed to teachers' successful learning of computer applications. Goals of the study were to explore: (1) how novice computer-using teachers differ from experienced computer-using teachers; (2) how inservice teachers differ from preservice teachers in computer learning; (3) what kinds of devices can help novice users master the computer tasks and accelerate the learning curve; and (4) what factors can contribute to effective learning about computer applications for teachers. (Author/MES)

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Effective Approaches to Teach Computer Applications to Teachers

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Effective Approaches To Teach Computer Applications To Teachers

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Abstract: Having a good command over basic computer applications is essential for teachers to integrate technology in the school. Teachers should learn how to maximize the power of computer for their teaching and administrative work. This paper focuses on some effective approaches that can help teachers learn to use computer applications successfully. First, common computer tasks were categorized based on their features. A series of enhancement instruments were designed and developed and implemented in computer application courses throughout a two-year period. Data were gathered and interpreted about effective approaches.

Overview

Computer has become an indispensable tool for teachers. Vockell and Sweeney (1993) point out that competent computer-using teachers used computers more often and in more effective ways than less competent teachers. Teachers today should learn how to maximize the power of computer for their work. Presently, there are more teachers using computers than ever. However, most computer-using teachers that we know spend time mainly on basic-level tasks, i.e., using word processing for typing papers or reports, browsing on the Internet, and sending e-mail. To take advantage of the capability that computers can offer, teachers need a higher level of computer expertise and an effective instructional approach is essential to help teachers master necessary computer applications and attain this level.

Teaching computer applications to teachers has presented challenges to college professors. Currently, computer application courses have become widely available in various teacher preparation programs. Many known factors, such as unequal access to hardware and software, diverse interest, background, and skill levels, insufficient learning resources, and inadequate platform differences, have discounted the computer instructors' effort and distracted the focus of proper instructional design and implementation.

There have been several studies examining how computers interact with users in the learning of application tasks. Larner and Timberlake (1995) suggest that the major obstacle to instructional technology is negative attitudes toward technology, and the lack of expertise or experience is the major reason for such negative attitudes. Studies also support that appropriate preservice and inservice training can reduce reluctance to use computers in classroom instruction (Brennan, 1991; Kolehmainen, 1992; Pina & Harris, 1993). Forcier (1996) points out that many researchers believe that one of the most effective strategies to engage teachers in acquiring the needed computer knowledge and skills is the task-oriented approach. To pursue effective approaches to optimize computer application instruction for teachers, the current study aims at exploring an integrative task-oriented approach and investigating effectiveness of various instructional devices.

Computer tasks and instructional enhancements

With many years of experiences in teaching computer applications to teachers, the author uses a modified framework, modeling the four domains of teaching (Danielson, 1996), which comprises planning and preparation, the classroom environment, instructional design, and professional responsibilities. To help learners appreciate the power and possibilities that computers may offer, task-oriented approach and hands-on activities are crucial to successful computer learning. However, simply putting teachers to work on computer tasks does not necessarily help them master needed skills and cope with the learning curve. An effective, meaningful approach is to connect the learning tasks with the learners' real-life experience. The author also finds that during teaching and learning, some tasks are more problematic than the others for certain users. With careful analysis, computer tasks may be categorized into the following three groups based on the nature of the tasks.

IR 019660

1. Conceptual tasks. The conceptual tasks include basic computer operational concepts such as how computer process information and how software operates. Some common examples for the conceptual tasks are as below.

- What is the difference between closing a document and quitting a program?
- How do computers process copying and pasting?
- What happened when a disk is initialized?
- How do computers handle graphics and text differently?
- Why do users have to specify a proper printer if more than one printer is connected to the computer?

2. Declarative tasks. The declarative tasks refer to the understanding of functions, features, and technical terms. The following are some common examples for the declarative tasks.

- Icon bar, tool panel, task bars, application menu, and ruler
- Justification, spacing, columnization
- Header and footer
- Macro or shortcuts
- Fonts, colors, and style sheet
- Cell references in a spreadsheet

3. Procedural tasks. The procedural tasks refer to intellectual steps to accomplish a given integrative task, or to trouble-shoot problems in a complex setting. The following tasks require the procedural knowledge.

- Organize a newsletter, make a calendar, create a slideshow, or customize a business card.
- Develop a database and a gradebook for an entire class.
- Correct some formatting errors by using search and replace function.
- Simplify the repetitive tasks with macro functions.
- Convert data files with different formats.

Although these task categories are fundamentally different, it is sometimes difficult to distinguish from one category from another. Frequently a procedural task may require the integration of various knowledge and skills from both conceptual and declarative task category. Smith and Ragan (1993) pointed out that in many cases conceptual and declarative tasks are essential to learning intellectual tasks. Anderson (1985) suggested that procedural knowledge must pass through the declarative knowledge stage. To enhance the computer application courses, examining the relationship between types of tasks and users' performances are indispensable.

Purpose of the study

This study focuses on various tasks, instructional device, and factors that may have contributed to teachers' successful learning of computer applications. Goals of this study are to explore the following issues:

- How do novice computer-using teachers differ from experienced computer-using teachers?
- How do inservice teachers differ from preservice teachers in computer learning?
- What kinds of devices can help novice users master the computer tasks and accelerate the learning curve?
- What factors can contribute to effective learning about computer applications for teachers.

The information regarding both preservice and inservice teachers' learning performance was collected. Other data from the past two years, including interviews with teachers, survey, and error frequency analysis from microcomputer application courses were also collected and interpreted.

Methodology:

Subjects:
The subjects of this study include 186 undergraduate preservice teachers and 112 graduate inservice teachers in the microcomputer application courses throughout four semesters in two years.

Instruments:
To assess students' performance, the following instruments were developed and used.
Initial survey: Students were surveyed for prior experience, interest, and attitudes toward computer applications.
Error log: Students were required to keep a weekly log and to report the errors they made.
Written quiz: Quizzes were used to assess if students had acquired needed conceptual and declarative knowledge.

Final portfolio: Students were required to develop an integrative portfolio to demonstrate what they had accomplished in the course in terms of tasks reflecting teachers' needs in a real classroom setting. They were allowed to focus on tasks related to either teacher's productivity or instructional enrichments or both. The grade for the portfolio was based on student efforts, thoughtfulness of the tasks, original ideas, creativity, and levels of difficulty. The final portfolio was used to assess intellectual procedural knowledge.
Assignments: Five types of exercises were given at various stages to help students consolidate their learning.
Post survey: Students were surveyed for perceptions about the usefulness of instructional enhancement device.
Final interview: Two students from each group were randomly picked for an interview at the end of each semester to provide feedback on the course.

Instructional enhancement devices
To help teachers smoothly and effectively master the learning of the application tasks, a series of instructional enhancements were designed and developed for this study. These devices are highlighted below.

- Detailed step-by-step information for the task in print and on the web.
- On-line help and tutorial.
- General information and terminology.
- Review of related tasks and features to the real life experience.
- Quizzes in the format of standardized test and on-line computer tasks as the formative evaluations.
- Team projects which provide students opportunities to learn from each other.
- A collection of model work samples and students' model work from the past.
- Five types of exercises, including, a) follow-along exercises as provided during in-class demonstrations, b) mock-up exercises as used after class to reinforce the skills learned, c) creative exercises (or open-ended mini projects), d) think-through exercises, and e) challenge exercises as to invoke deep thinking and application.

Procedure
Students (including all inservice and preservice teachers) started the course with an initial survey where they rated their own computer experience and skill levels. All students were then taught in depth about ClarisWorks, Netscape, and other application programs. As they made progress, they were asked to work on exercises, mini-projects, and portfolios. Students then reported on the errors they have made and the amount of time they had spent on which tasks. Students' quiz scores and final portfolio grades were also used to show their performance. At the end of the course, students were surveyed for their perceptions about the effectiveness of the instructional enhancement device. All data collected were analyzed to address the above-mentioned research issues.

Choice of the programs
ClarisWorks and Netscape programs were adopted as the primary tools for this study because they were readily available for various platforms in the computer lab. Both programs were also considered feasible to meet teachers' computer needs. Using the Netscape to browse the web as well as to construct a web page has been a popular practice that might increase teachers' willingness to put in good efforts for the exercises. ClarisWorks has been a popular integrated program which offers a wide range of tasks to address the needs in almost every aspect of teachers' work. In addition to ClarisWorks and Netscape, other popular programs, such as PowerPoint, HyperStudio, and some courseware titles were also adopted throughout the semester.

Results of the study

Student's self-reported computer experience and skill levels

Table 1. Self-rated as novice and experienced users

Computer experience	Preservice (Undergraduate)		Inservice (Graduate)	
Novice	63	21%	68	23%
Experienced	123	41%	44	15%

Students were asked to rate their own computer experiences and skill levels. Based on such information, they were categorized into four groups: preservice novice (PN=21%), preservice experienced (PE=41%), inservice novice (IN=23%) and inservice experienced (IE=15%) as shown in Table 1. Only a few students had prior experience in using the ClarisWorks and the Netscape, but their experiences were not extensive enough to affect the tasks to be learned and accomplished.

Error analysis of the computer tasks:

Table 2. Frequency of errors made for each knowledge categories as reported by students

	Conceptual tasks		Declarative tasks		Procedural tasks	
	Total	Average	Total	Average	Total	Average
PN (n=63)	958	15.21	1035	16.43	1534	24.35
PE (n=123)	578	4.70	674	5.48	718	5.84
IN (n=68)	1251	18.40	1358	19.97	1785	26.25
IE (n=44)	286	6.50	310	7.05	290	6.59
Total Novice (n=131)	2209	16.86	2393	18.27	3319	25.34
Total Experienced (n=167)		864 5.17		984 5.89		1008 6.04

Note: PN: Preservice novice PE: Preservice experienced
IN: Inservice novice IE: Inservice experienced

From what students reported about the computer errors they made for each task category throughout the semester, as shown in Table 2, it is obvious that novice users made more mistakes in all the categories than the experienced users.

What do they choose for mini-project exercises?

Table 3. Practice on advanced exercise and performance

	Mean Quiz Scores	Mean score for portfolio grade
Novice (n=131)	75.82	81.50
mockup tasks (n=89)	70.75	77.75
creative tasks (n=42)	86.56	89.45
Experienced (n=167)	92.10	82.40
mockup tasks (n=52)	87.95	77.95
creative tasks (n=115)	93.98	84.41

Students were given freedom to choose either basic mockup tasks or creative tasks for mini-projects as exercises. Although they were encouraged to attempt the creative tasks, many students chose to work on simple mockup tasks, as examples provided in class demonstration. As shown in Table 3, those who chose to do the creative tasks also performed better than those who did not. It is likely that those who chose to do mockup tasks did not feel comfortable or ready to do the creative tasks. The fact that fewer novice users chose to do integrative tasks may have explained this concern. However, the fact that those novice users who dared to try out the integrative tasks performed exceedingly well in their final portfolio probably suggests that integrative or creative tasks might help computer learners accomplish more.

Table 4. Mean quiz scores and portfolio grades between preservice and inservice teachers

	Quizzes	Portfolio
Preservice (n=186)	89	78
Inservice (n=112)	78.5	88.65

As shown in Table 4, undergraduate preservice teachers seemed to have better basic skills and did well on the quizzes. However, for the portfolio, the preservice teachers did not outperform the inservice teachers who had more experience in the public school classroom setting and had better ideas of how to apply computer skills.

Students' perceptions about the usefulness of the enhancement devices

Table 5. Mean scores of the helpfulness of the enhancement devices to learning

Type of enhancement device (Based on a 5-point scale of evaluation: 5=most useful)	Experienced users	Novice users
1. Detailed step-by-step information for the task	3.7	4.8
2. General information and terminology	3.3	4.7
3. Review and relate tasks and features to the real life experience	4.2	4.9
4. Quizzes	3.8	4.4
5. Team project	3.5	4.9
6. Model work samples/ group sharing	4.1	4.9
7. Exercises		
a. Mock-up exercise	3.3	4.8
b. Follow-along exercise	2.7	4.9
c. Creative exercise (open-ended project)	4.0	4.2
d. Thinking-through exercise	4.5	4.9
e. Challenge exercise	4.7	3.9

Based on a five-point scale survey (with 5 meaning most useful and 1 meaning least useful), students were asked to rate the usefulness of the enhancement devices for computer learning. The mean scores in Table 5 show that experienced users and novice users significantly disagreed on item 1, 2, 3, 7a, 7b, and 7e, where novice users appreciated receiving more general information and simple, easy-to-follow tasks.

Discussion of effective approaches

From the results of the study, the effective approaches may be characterized as the following.

- ***Computer time and access is essential***. Time spent on exercise is a widely known factor to the successful accomplishment of almost any learning tasks. Students who spent more time on the computer tasks performed better on both quizzes and the final portfolio than those who did not. Because both Netscape Navigator and ClarisWorks were available across the platform, a few teachers expressed their appreciation that they would be able to practice tasks at home. Six teachers bought new computers after they took the course because they sensed that easy access would make a greater difference for their learning.
- ***Move from basic to advanced tasks***. To accomplish the more complicated integrative tasks, users need to combine conceptual, declarative, and procedural knowledge and skills. Successful learners differ from the others not just in the knowledge and skills they have, but also in the way they explore computer programs. Those students who were flexible in trying out creative and integrative tasks performed better.
- ***The thinking-through process can help***. Thinking-through exercises may help students develop an ability to synthesize the information they have learned in order to develop more complex integrative tasks. A few novice students were not able to accomplish the given tasks and asked for help. When the tasks were analyzed and broken into smaller pieces, these students could handle individual tasks separately without problem. After the

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thinking-through exercises, they understood the concepts and were able to accomplish the given tasks. The thinking-through exercise help students master tasks and gain confidence.

- ***Prior teaching experience is helpful***. Several preservice teachers voiced concerns that they had no ideas about what kinds of teacher tasks they could do with computers. However, such concerns were not an issue for inservice teachers. This explains why preservice teachers had better conceptual and declarative knowledge (as shown in their quiz scores) but did not outperform inservice teachers on final portfolio. To help the preservice teachers, more model example tasks should be provided to help them connect their computer learning with real-life activities and to bridge the gap between preservice and inservice teachers.

Conclusion

Technology offers teachers the opportunity to become efficient at work and to conduct effective instruction. Task-oriented approaches to engage teachers in active learning about computer application is necessary but not sufficient. Teachers should acquire conceptual and declarative knowledge as well as the procedural knowledge described in this paper. The current study examined information about computer users' behavior and the type of tasks. Novice users needed to work on all types of tasks to improve their knowledge and skill levels.

To master computer applications, users should spend sufficient time on meaningful integrative tasks. The results suggested that practicing on integrative procedural tasks might help computer learners to perform better. The results also suggested that it is important to relate the computer tasks to the practical classroom setting and to lead undergraduate preservice students to become more aware of practicing teachers' tasks.

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